

## Replacement Sheet

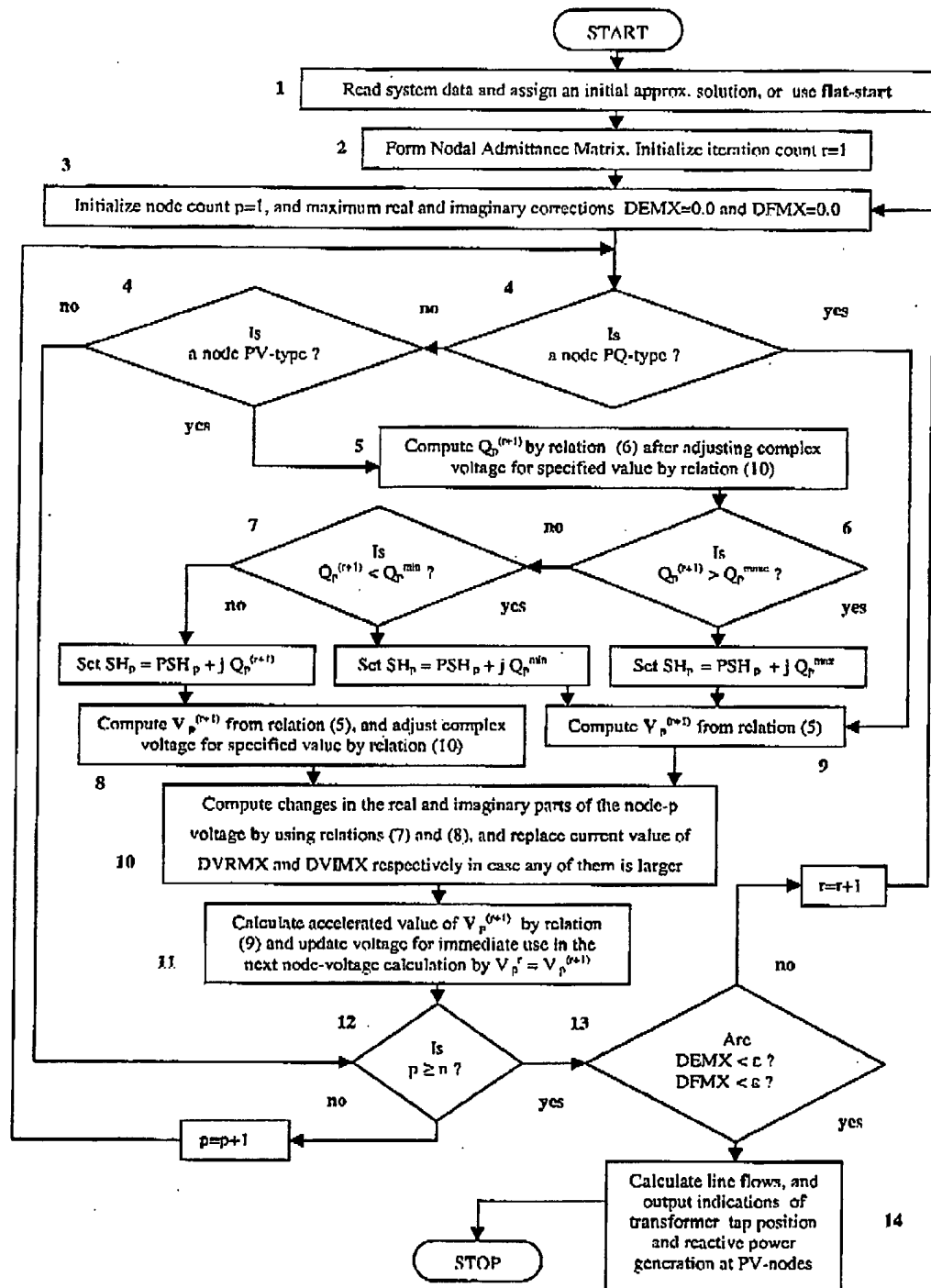


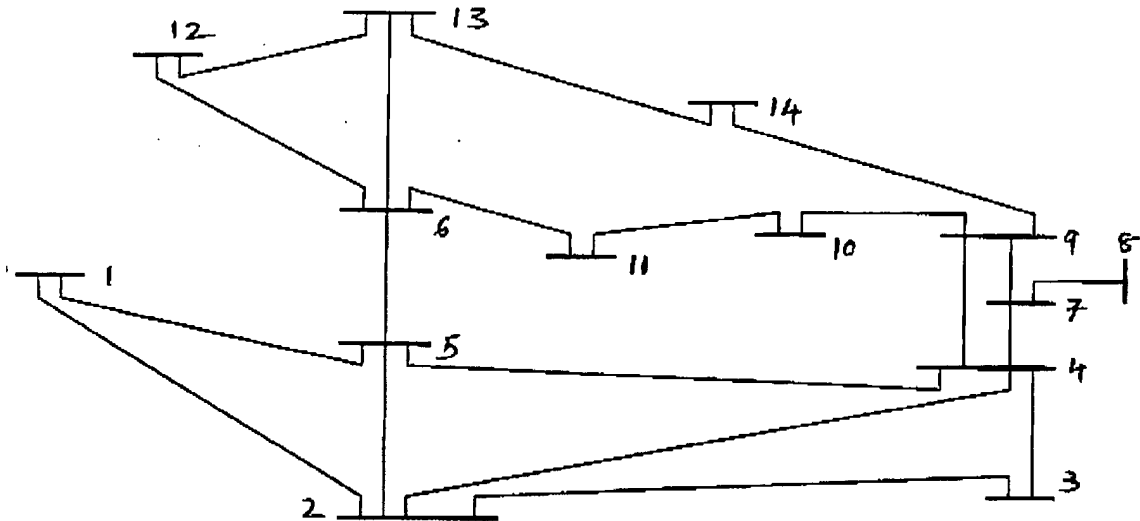
Fig. 1a: Prior Art: flow-chart of Gauss-Seidel Loadflow (GSL) Method

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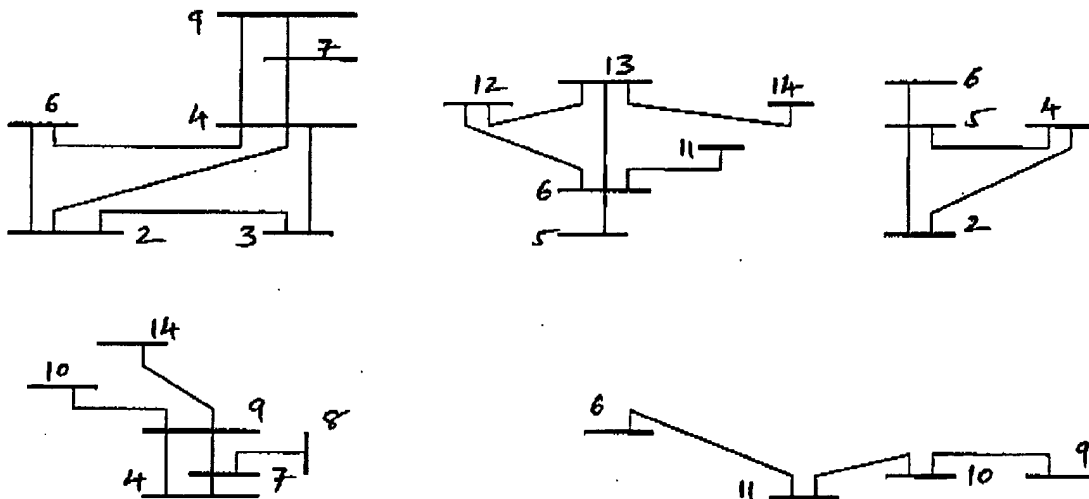
graph TD
    START([START]) --> a[a Read system data and assign an initial approx. solution or use slack-start]
    a --> b[b Form Nodal Admittance Matrix, calculate  $\cos\Phi_p$  &  $\sin\Phi_p$  using (19) and (20) & Initialize  $IPRP=ITRP$ ,  $r=0$ ]
    b --> c{c Is  $\cos\Phi_p < \cos(-48)$ ?  
 $P=1, \dots, (m+k)$ }
    c -- YES --> c1[c  $\cos\Phi_p = \cos(-48)$  &  $\sin\Phi_p = \sin(-48)$ ]
    c1 --> d[d Form admittance matrices  $[Y\theta]$  &  $[YV]$ , and factorize them & store as stated in calculation step-d]
    c -- NO --> d
    d --> e[e Compute  $\Delta P_i'$  &  $\Delta Q_j'$ , where  $i=1, \dots, (m+k)$  and  $j=1, \dots, m$ ]
    e --> f{f Is  $\Delta P_i' < \epsilon$  &  $\Delta Q_j' < \epsilon$ ?  
where  $i=1, \dots, (m+k)$  and  $j=1, \dots, m$ }
    f -- YES --> n[n Calculate line flows, and output indications of transformer tap position and reactive power generation at PV-nodes]
    f -- NO --> g[g Compute  $[RP]$  using eqn. (17) for PQ-nodes and using eqns. (21) and (22) for PV-nodes]
    g --> h[h Solve eqn. (13) for  $[\Delta\theta]$  and update voltage angles using,  $[\theta] = [\theta] + [\Delta\theta]$ ]
    h --> i[i Set voltage magnitudes of PV-nodes equal to the specified values, and increment  $ITRP = ITRP + 1$  and  $r = (ITRP + ITRQ)/2$ ]
    i --> j[j Compute  $\Delta P_i'$  &  $\Delta Q_j'$ , where  $i=1, \dots, (m+k)$  and  $j=1, \dots, m$ ]
    j --> k{ k Is  $\Delta P_i' < \epsilon$  &  $\Delta Q_j' < \epsilon$ ?  
where  $i=1, \dots, (m+k)$  and  $j=1, \dots, m$  }
    k -- YES --> n
    k -- NO --> l[l Compute  $[RO]$  using eqn. (18) for only PQ-nodes]
    l --> m[m Solve eqn. (15) for  $[\Delta V]$  and update PQ-node magnitudes using  $[V] = [V] + [\Delta V]$   
While solving (15), skip all the rows and columns corresponding to PV-nodes]
    m --> n1[n Adjust loadflow solution, if generator reactive power generation and transformer tap position limits are violated]
    n1 --> o[o Increment  $ITRP = ITRP + 1$  and  $r = (ITRP + ITRQ)/2$ ]
    o --> e
    n --> STOP([STOP])
  
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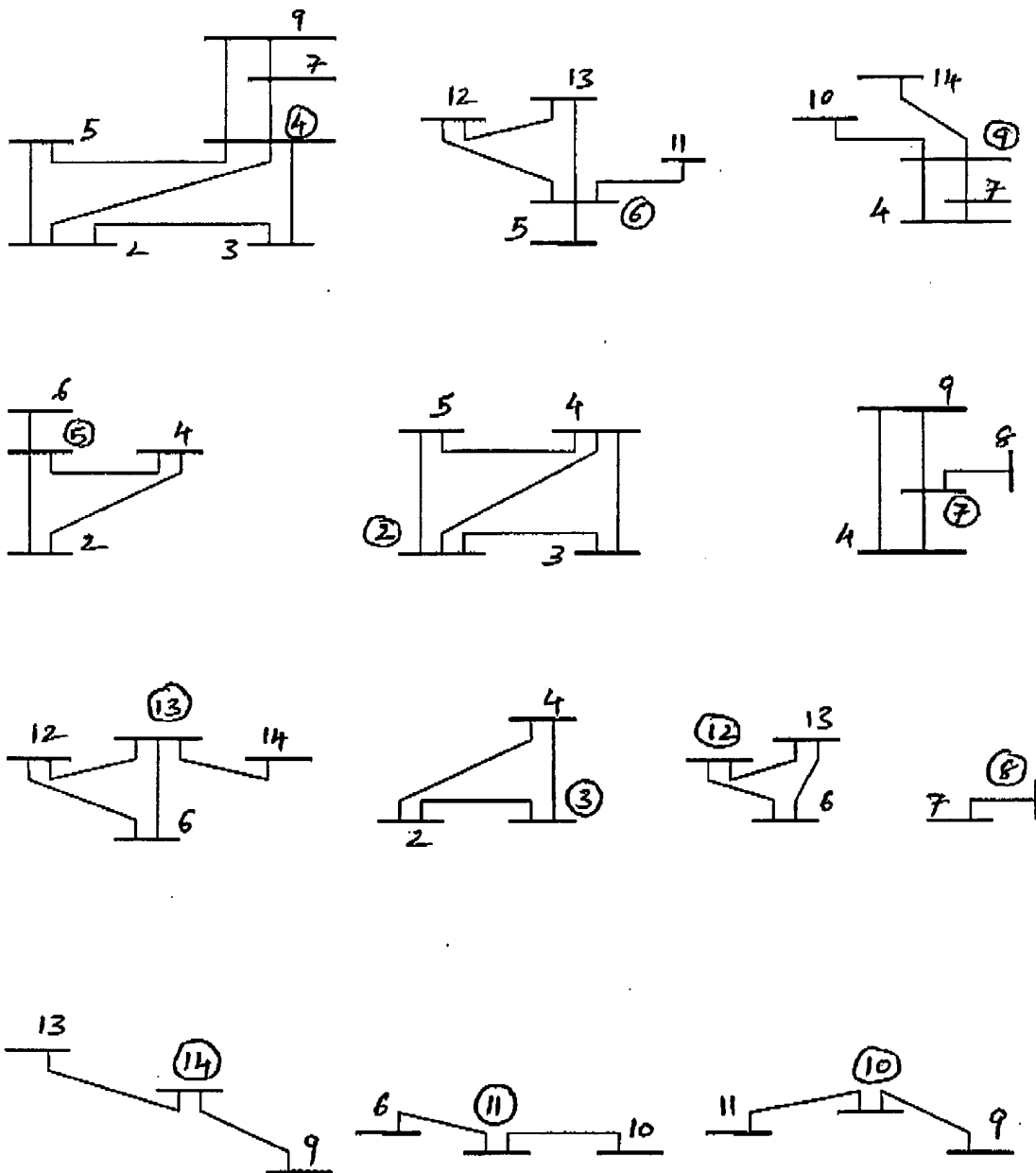


**Fig. 2a: One-line diagram of IEEE 14-node network**



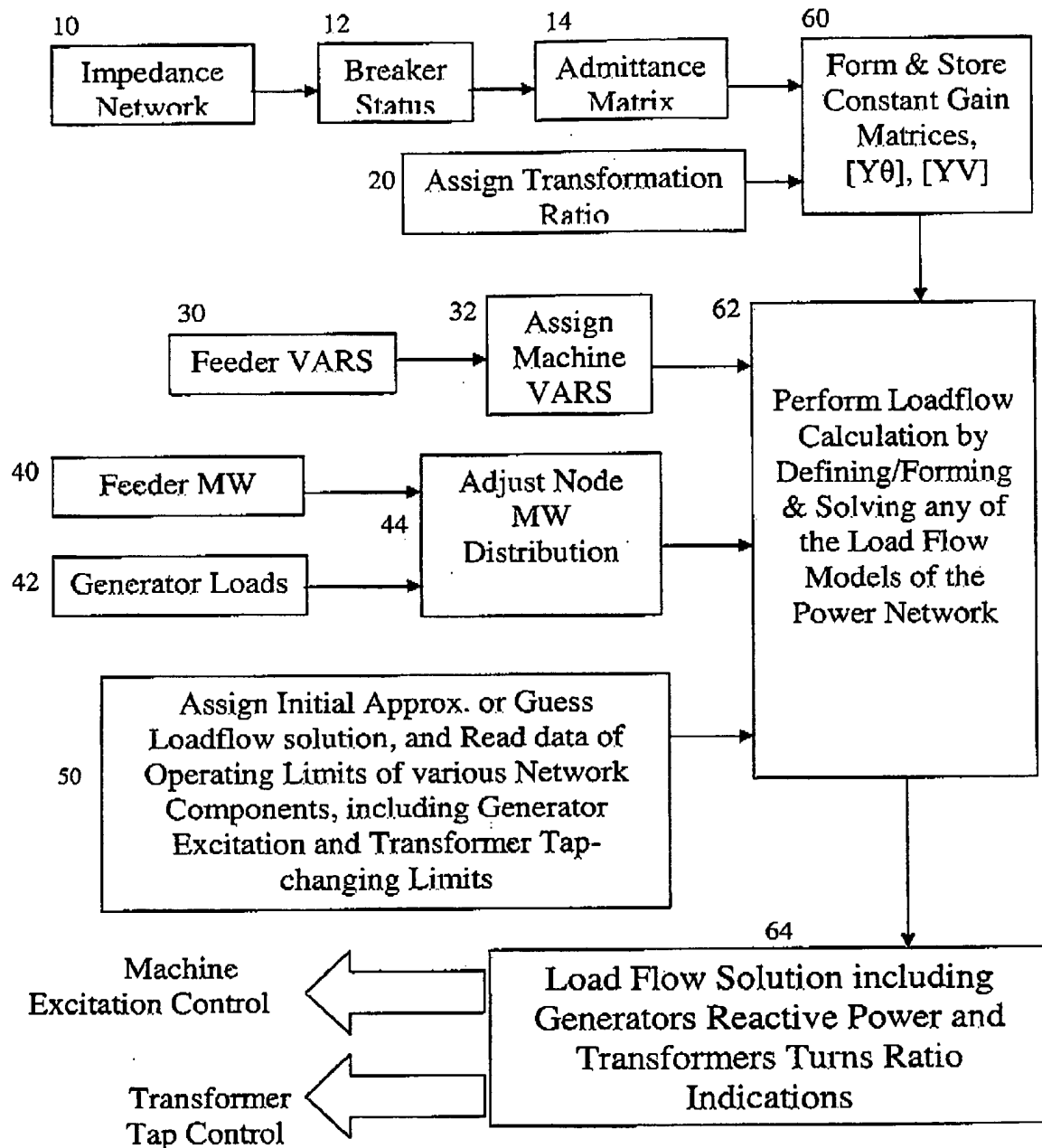
**Fig. 2c:** Non-redundant Level-1 sub-networks of fig. 2b are regrouped to reduce the number of processors required without increasing the number of nodes in any regrouped sub-network larger than the original largest sub-network of 6-nodes

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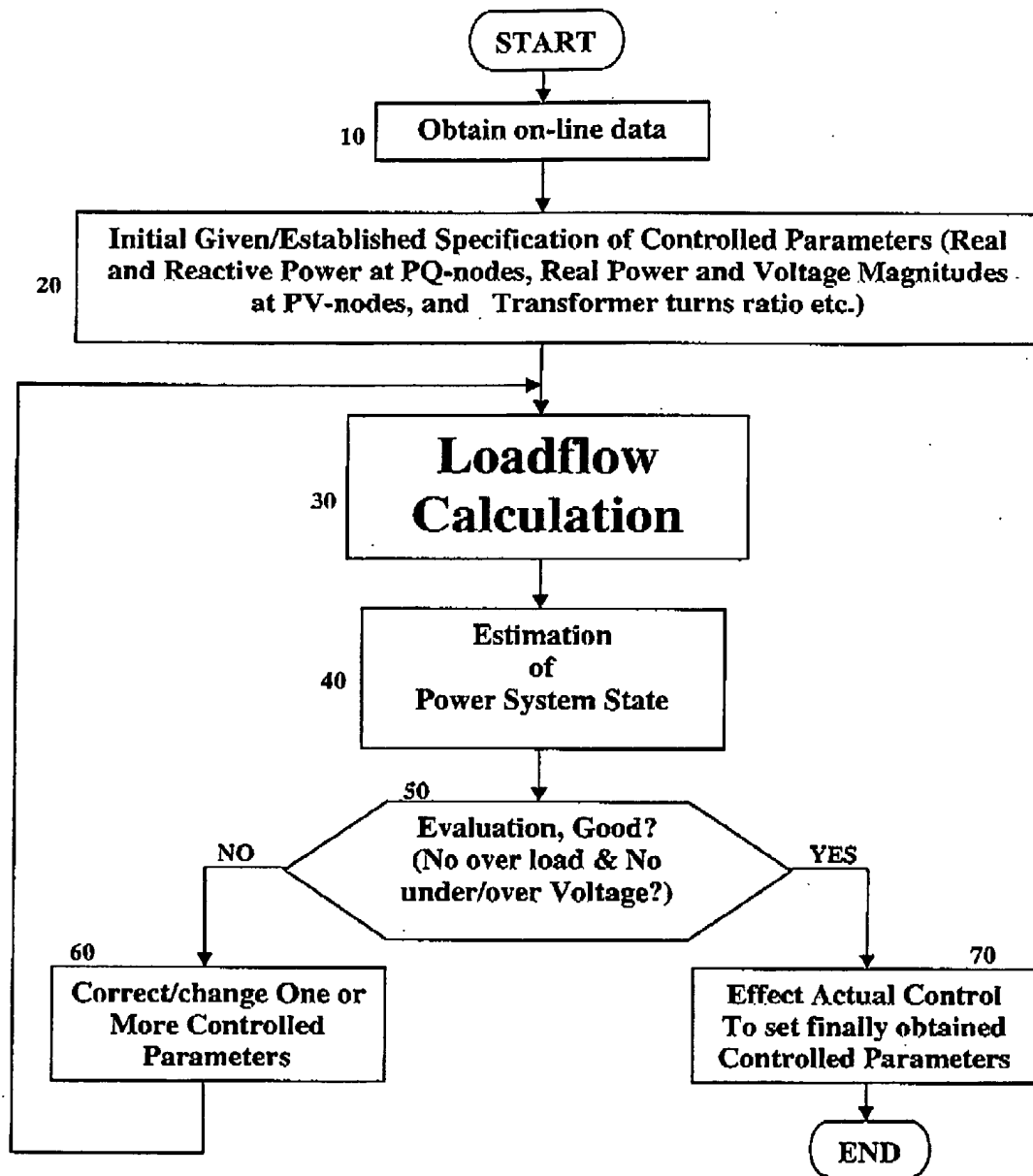


**Fig. 2b:** Level-1 sub-networks around circled nodes for the network of fig. 2a

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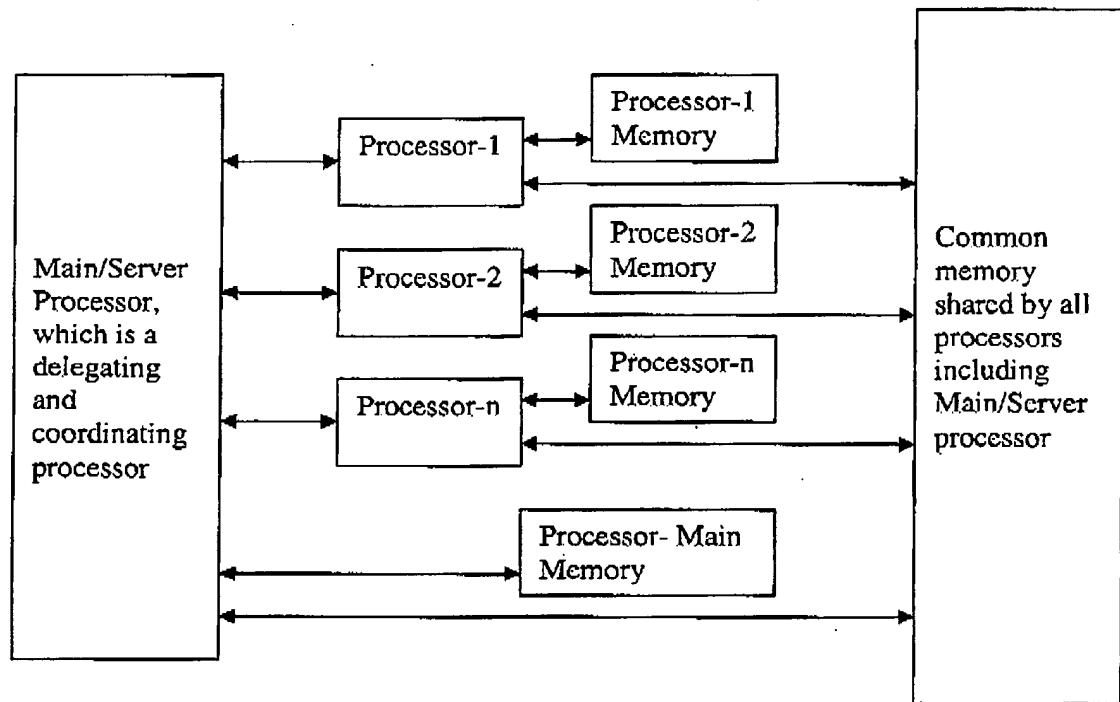


**Fig. 6: Load-Flow Calculation for Voltage Control in Electrical Power System**

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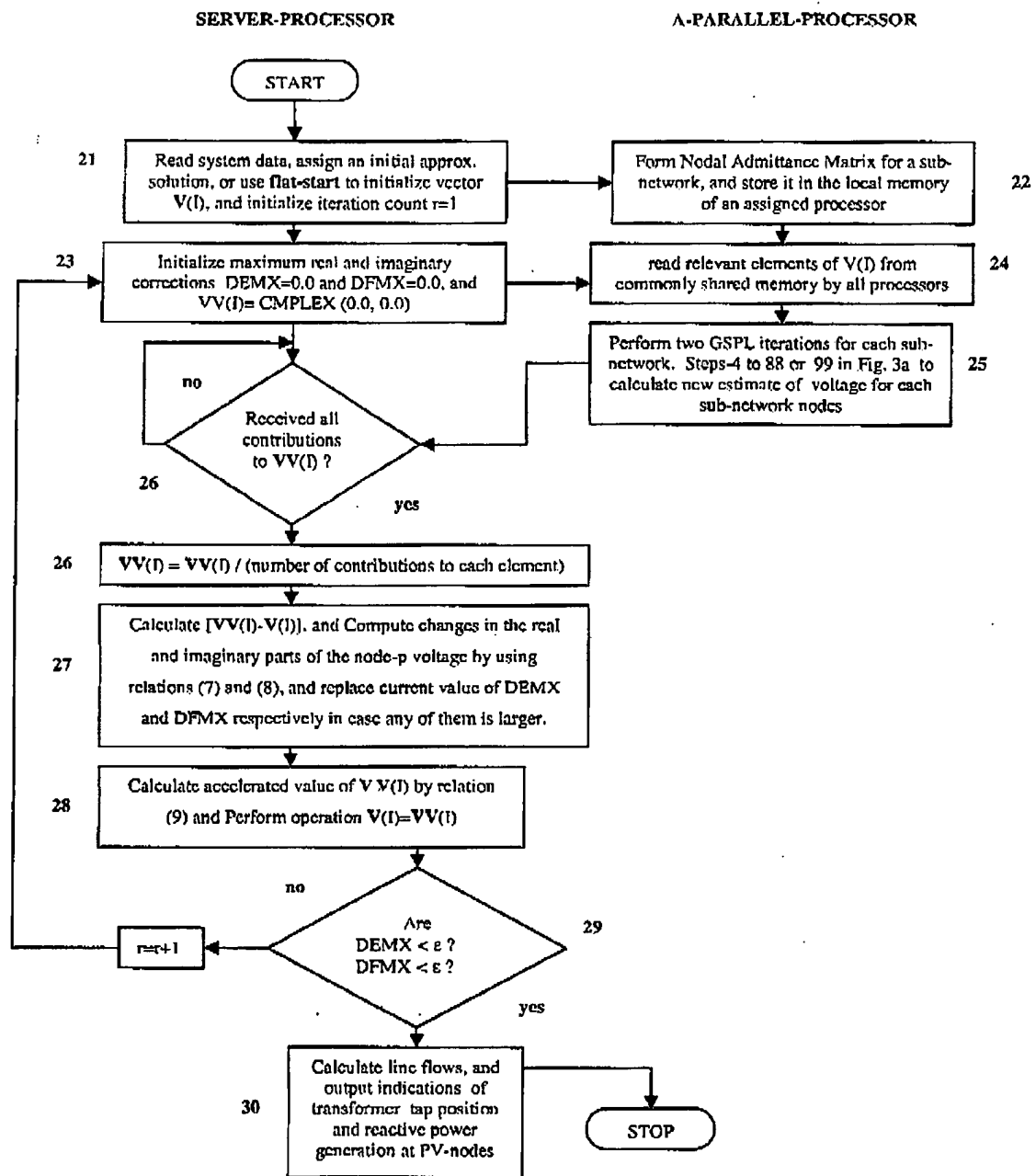
**Fig. 5: Loadflow Calculation in Power Flow Control and/or Voltage Control in Electrical Power System**

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**Fig. 4: Invented Parallel computer Architecture/organization**

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**Fig. 3b: Invention: flow-chart of Parallel-Gauss-Seidel-Patel Loadflow (PGSPL) Method**



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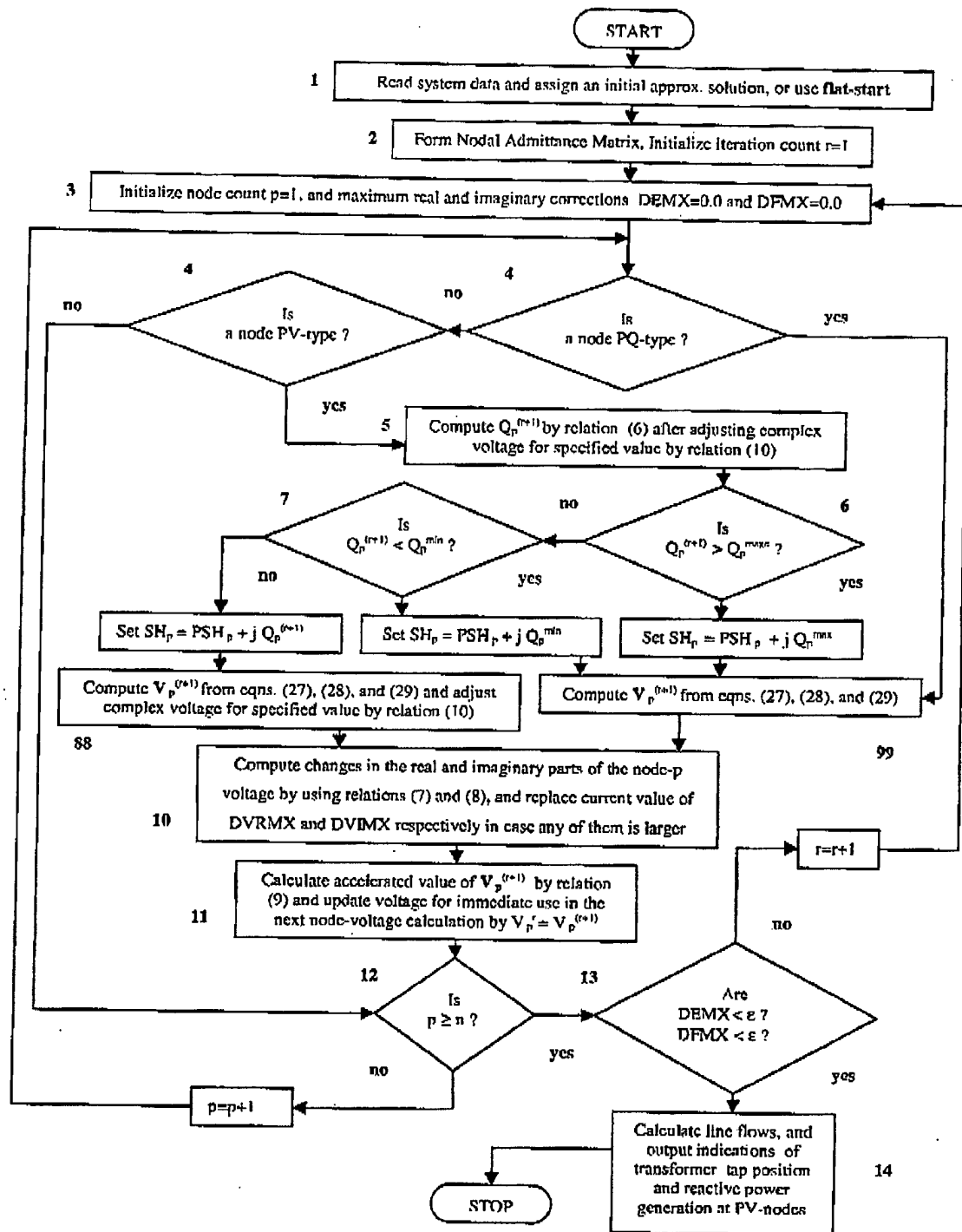
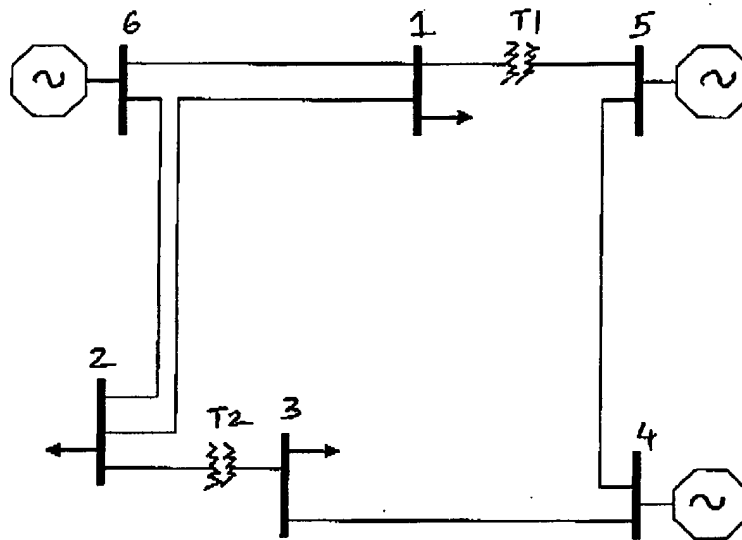


Fig. 3a: Invention: flow-chart of Gauss-Seidel-Patel Loadflow (GSPL) Method

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**Fig. 7: An Exemplary 6-node Power System**

Nodes: 1, 2, 3 are PQ-nodes

Nodes: 4 and 5 are PV-nodes

Nodes: 6 is the slack/swing/reference node

Transformers T1 and T2 are tap-changing